

Cisco – Configuring Basic MPLS Using OSPF

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Configuring Basic MPLS Using OSPF

Introduction

This sample configuration shows how to set up a Multiprotocol Label Switching (MPLS) network for further tasks such as Virtual Private Network (VPN) or traffic engineering (see these [Sample Configurations](#) on the MPLS Support Page for more information).

Mechanism

An MPLS network is commonly a backbone network comprised of MPLS-enabled routers called Label Switch Routers (LSR). Generally, the network consists of a core LSR with an edge LSR responsible for applying labels to packets.

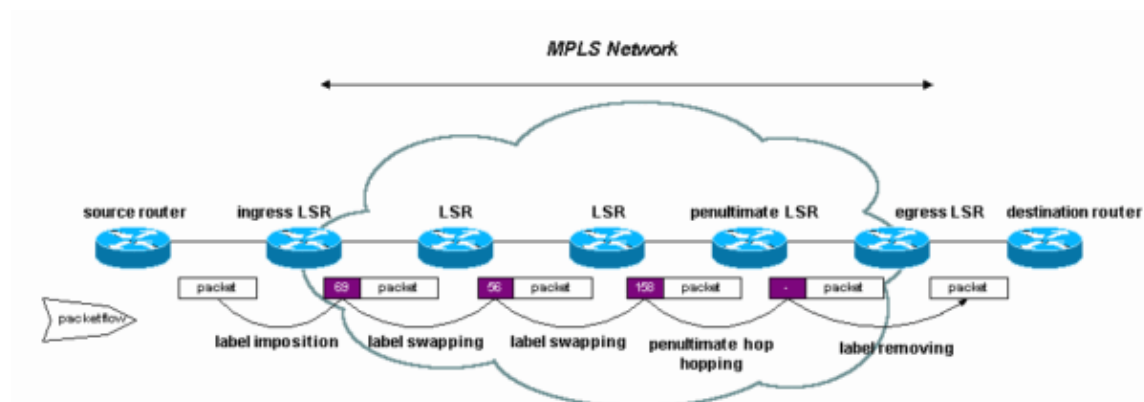
The setup mechanism of an MPLS network is the following:

2. Routing tables of the different LSRs are computed using an Interior Gateway Protocol (IGP). A link-state protocol such as Open Shortest Path First (OSPF) or Intermediate System-to-Intermediate System (IS-IS) is required if you're going to deploy MPLS Traffic Engineering.
1. A label distribution protocol (LDP) advertises the bindings between routes and labels. These bindings are checked against the routing table. If the route (prefix/mask and next hop) learned via the LDP matches the route learned via IGP in the routing table, an entry is created in the label forwarding information bases (LFIB) on the LSR.

The LSR uses the following forwarding mechanism:

3. Once an edge LSR receives an unlabelled packet, the Cisco Express Forwarding table is checked and a label is imposed on the packet if needed. This LSR is called the ingress LSR.
2. Upon the arrival of a labelled packet at the incoming interface of a core LSR, the LFIB provides the outgoing interface and the new label that will be associated with the outgoing packet.
1. The router before the last LSR (the penultimate hop) pops the label and transmits the packet without the label. The last hop is called the egress LSR.

The following diagram illustrates this network setup:

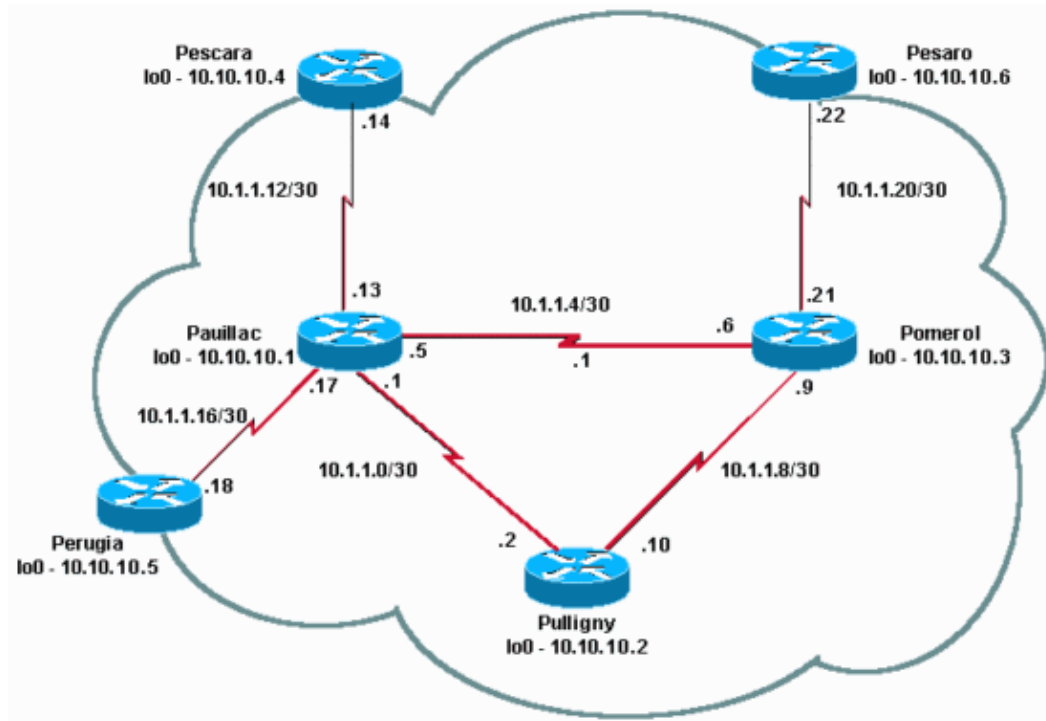


Hardware and Software Versions

This configuration was developed and tested using the software and hardware versions below.

- Cisco IOS® Software Releases 12.0(11)S and 12.1(3a)T
- Cisco 3600 routers

Network Diagram



Configurations

Quick Configuration Guide

4. Set up your network as usual (MPLS needs a standard IP connection in order to establish forwarding bases).
3. Ensure that the routing protocol (OSPF or IS-IS) is working correctly. These commands are underlined in the configurations below.
2. Enable **ip cef** (for better performances use **ip cef distributed** when available) in the general configuration mode (shown in bold in the following configurations).
1. Enable **mpls ip** (or **tag-switching ip** on older IOS versions) in the general configuration mode and in each interface (shown in bold in the following configurations).

Note: The LSRs must have (up) Loopback interfaces with an address mask of 32 bits and these interfaces must be reachable via the global IP routing table.

Configuration File

Pomerol

```
Current configuration:
!
version 12.0
!
hostname Pomerol
!
ip cef
!
interface Loopback0
 ip address 10.10.10.3 255.255.255.255
!
interface Serial0/1
 encapsulation frame-relay
!
interface Serial0/1.1 point-to-point
 ip address 10.1.1.6 255.255.255.252
 mpls ip
 frame-relay interface-dlci 301
!
interface Serial0/1.2 point-to-point
 ip address 10.1.1.9 255.255.255.252
 mpls ip
!
interface Serial0/1.3 point-to-point
 ip address 10.1.1.21 255.255.255.252
 mpls ip
 frame-relay interface-dlci 306
!
router ospf
  network 10.1.1.0 0.0.0.255 area 9
  network 10.10.10.0 0.0.0.255 area 9
!
ip classless
!
end
```

Pulligny

```
Current configuration:
!
version 12.1
!
hostname Pulligny
!
ip cef
!
interface Loopback0
 ip address 10.10.10.2 255.255.255.255
!
interface Serial0/1
 encapsulation frame-relay
!
interface Serial0/1.1 point-to-point
 ip address 10.1.1.2 255.255.255.252
 mpls ip
 frame-relay interface-dlci 201
!
interface Serial0/1.2 point-to-point
 ip address 10.1.1.10 255.255.255.252
```

```

mpls ip
frame-relay interface-dlci 203
!
ip classless
!
router ospf
  network 10.1.1.0 0.0.0.255 area 9
  network 10.10.10.0 0.0.0.255 area 9
!
end

```

Pauillac

```

Current configuration : 2366 bytes
!
version 12.1
!
hostname pauillac
!
ip cef
!
interface Loopback0
 ip address 10.10.10.1 255.255.255.255
!
interface Serial0/0
 encapsulation frame-relay
!
interface Serial0/0.1 point-to-point
 ip address 10.1.1.1 255.255.255.252
 mpls ip
 frame-relay interface-dlci 102
!
interface Serial0/0.2 point-to-point
 bandwidth 512
 ip address 10.1.1.5 255.255.255.252
 mpls ip
 frame-relay interface-dlci 103
!
interface Serial0/0.3 point-to-point
 ip address 10.1.1.13 255.255.255.252
 mpls ip
 frame-relay interface-dlci 104
!
interface Serial0/0.4 point-to-point
 ip address 10.1.1.17 255.255.255.252
 mpls ip
 frame-relay interface-dlci 105
!
!
router ospf
  network 10.1.1.0 0.0.0.255 area 9
  network 10.10.10.0 0.0.0.255 area 9
!
ip classless
!
end

```

Sample show Output

Commands used in the Configuring Basic MPLS Using IS-IS sample configuration are also applicable.

To illustrate this sample configuration, look at a particular destination, for example 10.10.10.4, on the Pomerol LSR.

First, check the **ip route** for this destination in the IP routing table:

```
Pomerol#show ip route 10.10.10.4
Routing entry for 10.10.10.4/32
  Known via "ospf 9", distance 110, metric 391, type intra area
  Redistributing via ospf 9
  Last update from 10.1.1.5 on Serial0/1.1, 00:05:34 ago
  Routing Descriptor Blocks:
  * 10.1.1.5, from 44.44.44.1, 00:05:34 ago, via Serial0/1.1
    Route metric is 391, traffic share count is 1
```

The MPLS forwarding table is the label switching equivalent of the IP routing table for standard IP routing. It contains incoming and outgoing labels and descriptions of the packets. You can check it using the **show mpls forwarding-table** command:

```
Pomerol#show mpls forwarding-table
Local  Outgoing  Prefix          Bytes tag  Outgoing     Next Hop
tag    tag or VC  or Tunnel Id    switched   interface
16     Untagged   6.6.6.7/32      0          Se0/1.3      point2point
17     Pop tag    10.1.1.12/30    0          Se0/1.1      point2point
18     Pop tag    10.10.10.1/32   0          Se0/1.1      point2point
19     Pop tag    10.10.10.6/32   782        Se0/1.3      point2point
20     22         10.10.10.4/32   48         Se0/1.1      point2point
21     21         10.10.10.5/32   182        Se0/1.1      point2point
22     Pop tag    10.1.1.16/30    0          Se0/1.1      point2point
```

To see MPLS forwarding table details:

```
Pomerol#show mpls forwarding-table 10.10.10.4 32 detail
Local  Outgoing  Prefix          Bytes tag  Outgoing     Next Hop
tag    tag or VC  or Tunnel Id    switched   interface
20     22         10.10.10.4/32   48         Se0/1.1      point2point
      MAC/Encaps=4/8, MTU=1520, Tag Stack{22}
      48D18847 00016000
      No output feature configured
      Per-packet load-sharing, slots: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
```

The label bindings are the labels associated with a particular destination and you can see them using one of the following commands (depending on what IOS version and which label distribution protocol you are using):

```
Pomerol#show mpls ldp bindings 10.10.10.4 32
10.10.10.4/32, rev 77
  local binding:  label: 20
  remote binding: lsr: 10.10.10.1:0, label: 22
  remote binding: lsr: 10.10.10.6:0, label: 24

Pomerol#show tag-switching tdp bindings 10.10.10.4 32
tib entry: 10.10.10.4/32, rev 77
  local binding:  tag: 20
  remote binding: tsr: 10.10.10.1:0, tag: 22
  remote binding: tsr: 10.10.10.6:0, tag: 24
```

Note that labels for each forwarding class have been established at each LSR, even if they are not on the preferred (shortest) path. In this case, a packet destined to 10.10.10.4/32 can go by 10.10.10.1 (with label 22) or by 10.10.10.6 (with label 24). The LSR chooses the first solution because it is the shortest one. This

decision is made using the standard IP routing table (which in this case, has been built using OSPF).

To check that Cisco Express Forwarding is working properly and that tags will be swapped correctly, do the following:

```
Pomerol#show ip cef 10.10.10.4 detail
10.10.10.4/32, version 154, cached adjacency to Serial0/1.1
0 packets, 0 bytes
  tag information set
    local tag: 20
    fast tag rewrite with Se0/1.1, point2point, tags imposed {22}
  via 10.1.1.5, Serial0/1.1, 0 dependencies
    next hop 10.1.1.5, Serial0/1.1
    valid cached adjacency
    tag rewrite with Se0/1.1, point2point, tags imposed {22}
```

Related Information

- [MPLS Support Page](#)
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